

An Update on the Risks of CO₂ Injection and Value of Enhanced Oil Recovery (in Texas)

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|2M Associates

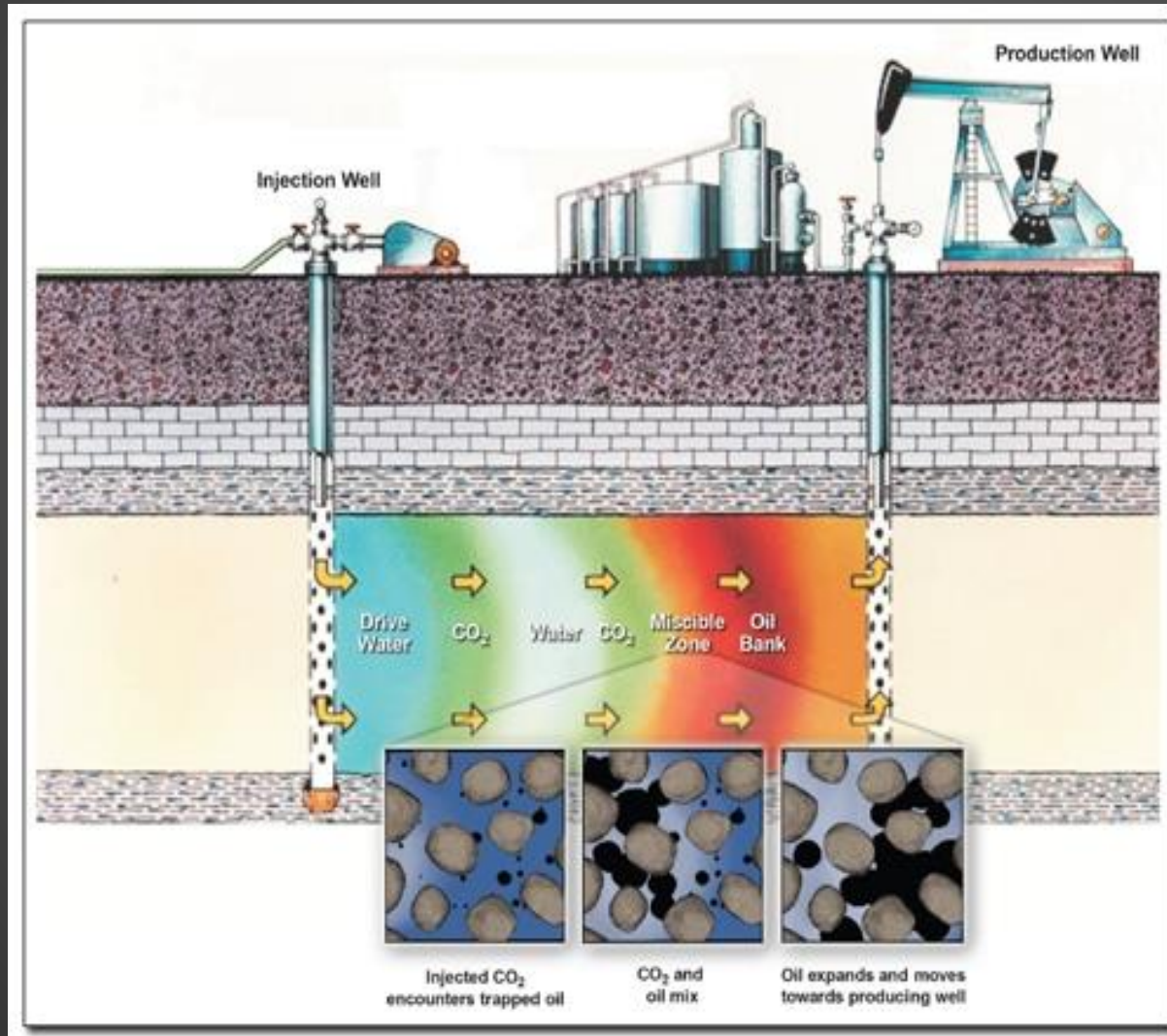


Co-Authors and Acknowledgements

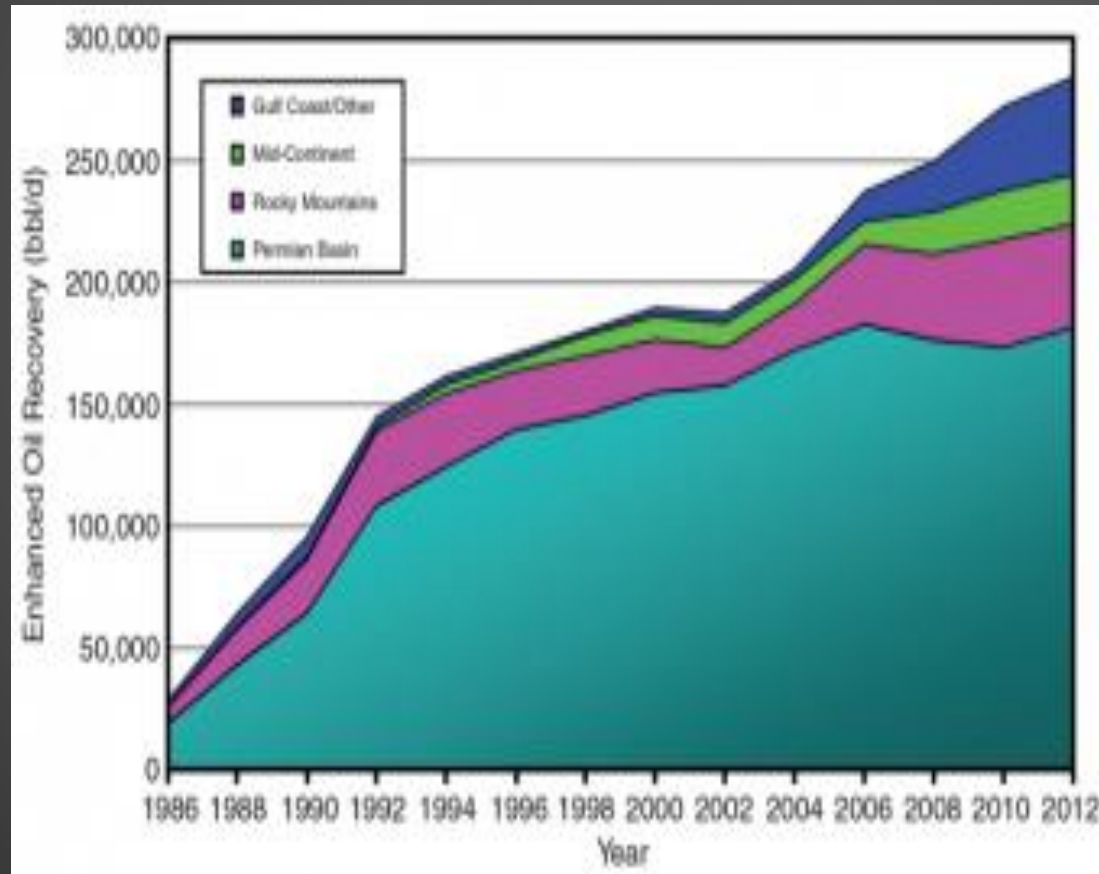
Many thanks to those who did the most

- Don Whitely, I2M Associates
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- Ryan Gleason, Astra Environmental
- Our clients, TCEQ, CDC, and RCT and Andrew Fono, formerly of Winstead and Haynes & Boone

Enhanced Oil Recovery Via CO₂ Injection



Before Recent Shale Oil Increase, CO2 EOR had a major impact on US Oil Production



Preparation of Well for CO2 Injection



Source: Kari Suedel, EERD Staff Photographer and Janet Crossland

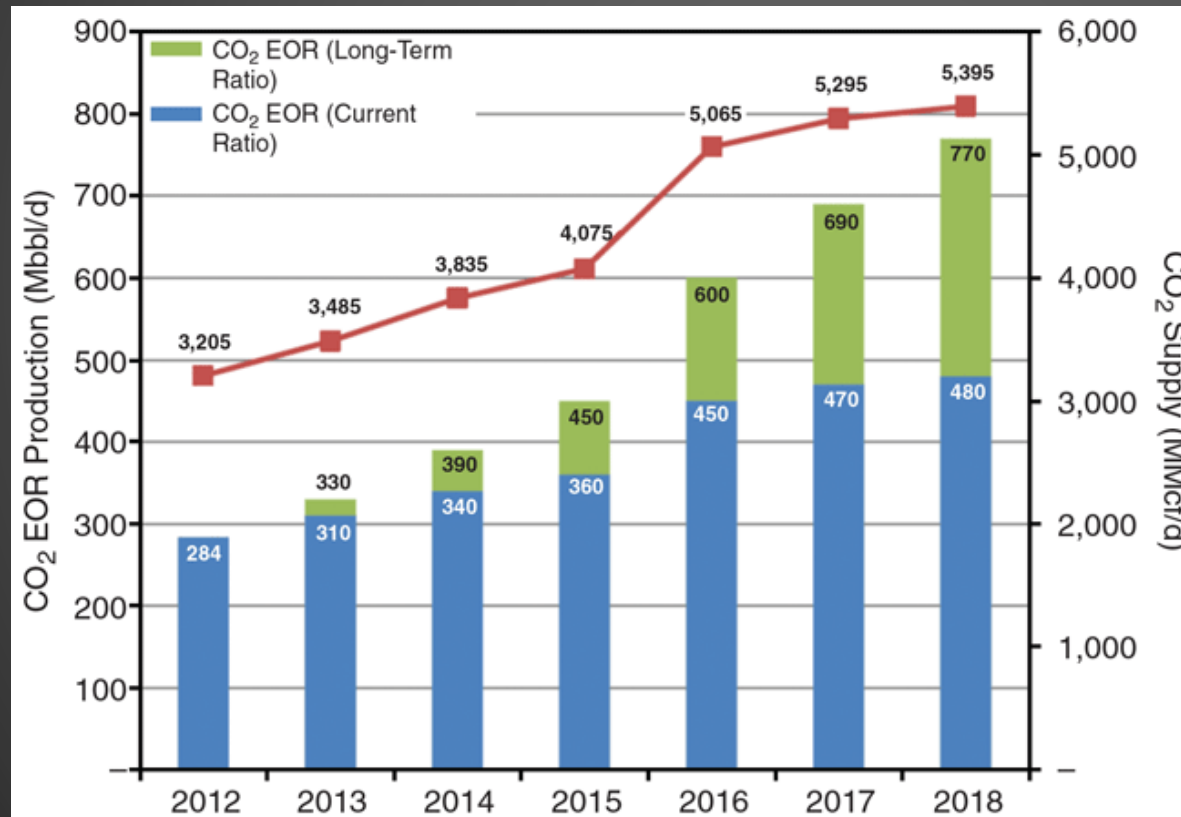
Primary Risks of CO₂ Injection

- ▶ Price is currently low; may increase if tax put on all CO₂
- ▶ Sequestration Risk: Acid Gas (often disposed of with H₂S) can escape through old wells not properly cemented
- ▶ Operational Risk: Acid Gas repairs production/injection tubing and material upgrades; short circuiting in subsurface injection zone; potential loss via faults
- ▶ Primary Business Risk: Availability and price of CO₂

ARI Estimate of Value of CO₂ EOR Projects

Revenue Recipient	Value Chain Function	Revenues per Barrel (\$)	Total* (Billions of \$)
Power/industrial companies	Sale of captured CO ₂ emissions	\$13.20	\$1,320
Federal/state treasuries	Severance/income taxes	\$19.80	\$1,980
U.S. economy	Services, materials and sales	\$26.50	\$2,650
Other	Private mineral rights	\$7.70	\$770
Oil and gas industry	Return of/on capital	\$17.80	\$1,780
	Total	\$85.00	\$8,500

Supply of CO₂ is Limiting Expansion of EOR, Why?



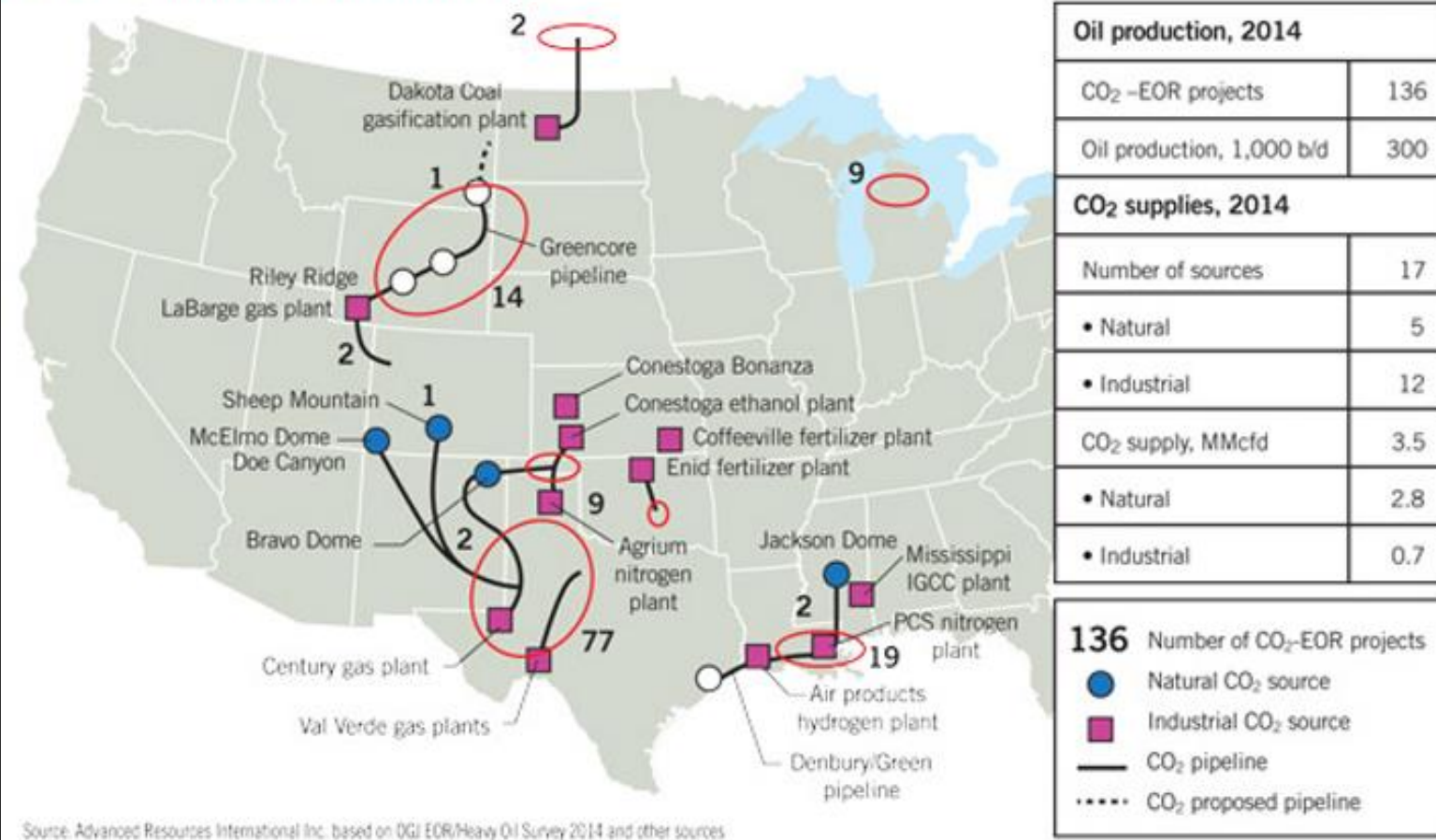
Why Limited Supply

- ▶ Natural/Industrial Supply controlled by limited number of players
- ▶ Supply committed to a limited number of energy companies
- ▶ Natural supply plentiful; industrial power industry source plentiful but uncertainty in whether power plants will close sooner than represented
- ▶ Supply requires pipeline transportation, so deals involve long term commitments by larger players
- ▶ Current shale oil & gas market is cheap; business incentives increase with price of oil
- ▶ Lack of governmental support for commercial pipelines and open market for CO₂
- ▶ No current regulatory limits on industrial emissions of CO₂

Current Supplier and EOR Locations and Transporters

CO₂-EOR OPERATIONS, CO₂ SOURCES: 2014

FIG. 1



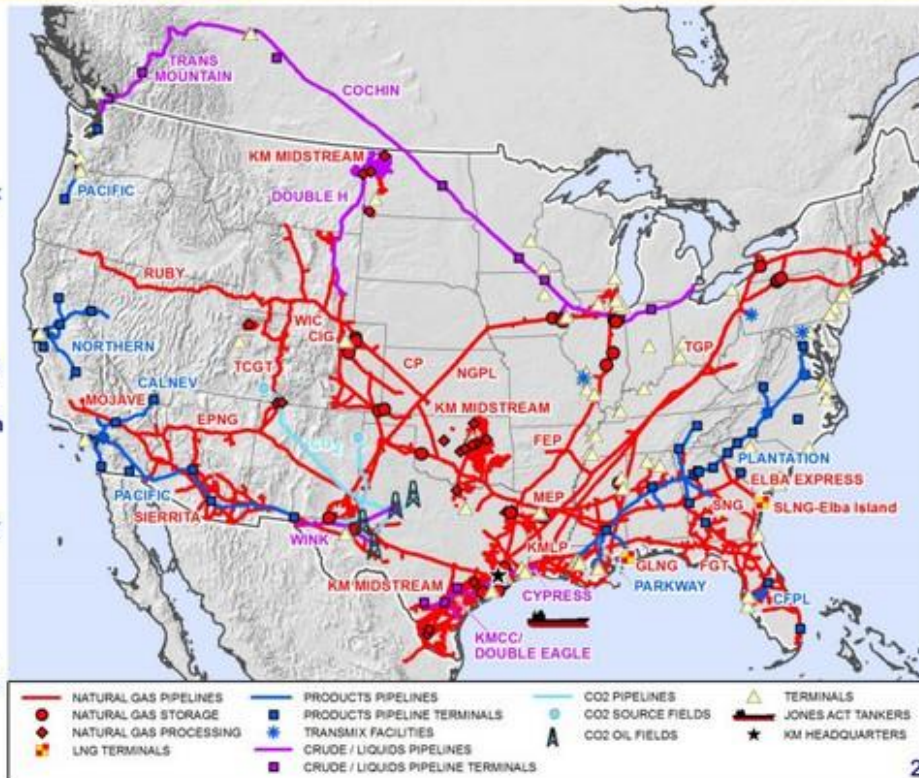
Source: Advanced Resources International Inc. based on OGI EOR/Heavy Oil Survey 2014 and other sources

Kinder Morgan major player in CO2 Enhanced Oil Recovery; Oxy Primary User



Unparalleled Asset Footprint Largest Energy Infrastructure Company in North America

- **\$18.2 billion of currently identified organic growth projects**
- **Largest natural gas network in North America**
 - Own an interest in/ operate ~69,000 miles of natural gas pipeline
 - Connected to every important natural gas resource play in the U.S., including: Eagle Ford, Marcellus, Utica, Bakken, Uinta, Haynesville, Fayetteville and Barnett
- **Largest independent transporter of petroleum products in North America**
 - Transport ~2.1 MMBbl/d^(a)
- **Largest transporter of CO₂ in N. America**
 - Transport ~1.2 Bcf/d of CO₂^(a)
- **Largest independent terminal operator in North America^(b)**
 - Own an interest in or operate 180 liquids/ dry bulk terminals
 - ~152 MMBbls domestic liquids capacity
 - Handle ~65 MMtons of dry bulk products^(a)
 - Strong Jones Act shipping position
- **Only Oilsands pipe serving West Coast**
 - Transports ~300 MBbl/d to Vancouver/ Washington State; proposed expansion takes capacity to 890 MBbl/d



(a) 2016 budget.
(b) Includes KMI/ BP JV terminals.



<http://go.to/funpic>

Conclusions

- Considerable regulatory, economic, business and operational uncertainties have created risks limiting expansion of the beneficial use of **CO₂** injection for EOR
- Environmentalists are generally opposed to any activity that supports Oil & Gas production, even if beneficial to the environment
- Working together rather than litigating yields better results: author has supported successful Stakeholders groups permitting resolutions

